QUICK-CONNECT MECHANISM

Reference to Related Applications

This is a divisional application based on and claiming benefit of continuation-in-part application 09/783,082 filed Feb. 15, 2001 based on international application no. PCT/CA00/00521, filed May 3, 2000 and designating the United States which claimed the benefit of United States provisional application no. 60/132,226, filed May 3, 1999.

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to a quick-connect mechanism for receiving tools and tool bits, the mechanism being embodied in a holder which it turn may be mounted, permanently or removably, in a driving tool such as a power drill for example, or a hand tool such as a screwdriver for example.

Description of the Prior Art

Traditional quick-connect mechanisms for connecting tools to a holder are shown in, for example, US 5,779,404 (Jore). This mechanism has the apparent drawback of not allowing an operator to insert and release the tool using only one hand (the other hand would be used to grip the power tool or hand tool which would power the tool/holder), necessitating the sleeve to be retracted manually to release the tool from the holder.

SUMMARY OF THE INVENTION

It is an object of the invention to provide an improved holder for tools or tool bits such as drill bits, screwdriver bits or the like, the holder being simple to produce and assemble, and yet performing the required functions well.

The invention provides a holder which has a quick-connect mechanism actuated by inserting a bit, the bit engaging means to force retraction of a collar, where the collar actuates means for engaging the bit, and released by manual retraction of the collar, whereby the tool bit is release from the holder.

In the invention, a holder for holding a tool bit comprises an elongate connector means attachable to a power tool/hand tool, the connector having a longitudinal hole with a cross-section corresponding to the cross-section of a mounting portion of the tool bit. The connector means further includes a first radial hole running from an outside surface of the connector to the longitudinal hole, the first radial hole having a large diameter bore portion at the outside surface of the connector and a small diameter bore portion at the longitudinal hole, and a substantially truncated hemispherical shape. A substantially spherical locking ball is movably arranged in the first radial hole, cooperating with the substantially truncated hemispherical shape of the first radial hole, where the locking ball cooperates with a circumferential groove in the tool bit to lock the tool bit in place when the tool bit is fully inserted into the holder. An outer sleeve is arranged to reciprocally slide over the first connector between two end positions. The outer sleeve has a first end facing the tool bit and a second end facing the tool mount. The connector means is attachable to a power tool or hand tool via a tool mount. The outer sleeve has a stepped inside diameter, having a smaller diameter part facing the power tool or hand tool, and a larger diameter part facing the tool bit. A bevelled transition is arranged between the two different diameter parts, the bevelled transition is arranged to cooperate with a transition ball. A sleeve biasing means, for example a coil spring, is arranged to bias the sleeve away from the tool mount. The transition ball is arranged in a transition hole in the connector means. The transition hole is substantially radial, and preferably, but not necessarily, angled so that the bottom of the transition hole is arranged further from the tool mount than the top of the transition hole. Alternatively, the transition hole is substantially perpendicular to the longitudinal hole. Thus, the transition ball, which has a diameter substantially corresponding to the diameter of the transition hole, is slidable between a first position at the bottom of the transition hole, to a second position protruding from the top of the transition hole. The bevelled transition is pressed against the transition ball by the sleeve biasing means.

The sleeve is held in its end positions by a mechanism comprising a locking cavity, which cooperates with a locking ring arranged in a locking ring groove arranged on the elongate connector means, to limit the stroke of the sliding movement of the sleeve

along the elongate connector means in the direction towards the tool mount or handle by the locking ring blocking further movement because the locking ring contacts the edge of the locking cavity, and in the direction towards the tool bit by the bevelled transition contacting the transition ball in its position at the bottom of the transition hole, which protrudes enough to block the movement of the sleeve when the bevelled transition contacts the larger diameter portion of the elongate connector means. In the latter position, the sleeve is prevented from sliding towards the tool mount or handle, under the biasing influence of the biasing means, by the frictional forces present between the inside of the sleeve and the locking ring.

When the tool bit is inserted into the longitudinal hole, the inserted end of the tool bit will push the transition ball radially outwards in the transition hole. The transition ball is pressed by the inserted end of the tool bit, from its position at the bottom of the transition hole towards the sleeve and the bevelled transition, thus pressing the sleeve towards the tool mount or handle. A locking portion of the sleeve effectively blocks the locking ball from movement in the first radial hole, locking the tool bit in the longitudinal hole.

In a further embodiment of the invention, the sleeve has a locking cavity, which cooperates with a locking ring arranged in a locking ring groove arranged on the elongate connector means to limit the stroke of the sliding movement of the sleeve along the elongate connector means, by either edge of the locking cavity contacting the sides of the locking ring to provide the blocking of the sleeve. The outer sleeve is arranged to reciprocally slide over the connector means between two end positions, and has a stepped inside diameter, having a smaller diameter part facing the tool mount and a larger diameter part facing the tool bit. A middle diameter part is arranged between the smaller and the larger diameter parts, having a diameter which is larger than the diameter of the small diameter part but smaller than the diameter of the large diameter part. The middle diameter part is arranged to house a sleeve biasing means. A bevelled transition is arranged between the large and middle diameter parts. The

bevelled transition functions similarly to the bevelled transition described for the earlier embodiment, in cooperation with a transition ball.

Further features of the invention will be described or will become apparent in the course of the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention may be more clearly understood, the preferred embodiment thereof will now be described in detail by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a sectional side view of a device according to a first embodiment of the invention, showing an exchangeable bit tool in its locked position in the tool holder,

Fig. 2 is a frontal view of the device of Fig. 1,

Fig. 3 is a sectional side view of the device of Fig. 1, showing the device in a position without an inserted tool bit,

Fig. 4 is a sectional side view of the device of Fig. 1, showing the device in a position where the outer sleeve is pulled back to release an inserted tool bit from the holder,

Fig. 5 is a sectional side view of an outer sleeve according to the invention,

Fig. 6 is a sectional side view of a first connector according to the invention,

Fig. 7 is a side view of a first connector according to the invention, seen from the side having the second radial hole,

Fig. 8 is a sectional view of a locking ball depressor according to the invention,

Fig. 9A is a top view of a guiding bar according to the invention,

Fig. 9B is a side view of a guiding bar according to Fig. 9A,

Fig. 10 is an elevational perspective view of a device according to a second embodiment of the invention, showing the device in a position without an inserted tool bit,

Fig. 11A is a sectional side view of the device according to Fig. 10, showing the device in a position where a tool bit has been inserted to the first collar displacement ball,

Fig. 11B is a section along line 1-1 of Fig. 11A,

Fig. 12A is a sectional side view of the device according to Fig. 10, showing the device in a position where a tool bit has been inserted to the second collar displacement ball,

Fig. 12B is a section along line 2-2 of Fig. 12B,

Fig. 13A is a sectional side view of the device according to Fig. 10, showing the device in a position where a tool bit has been inserted to the locking ball,

Fig. 13B is a section along line 3-3 of Fig. 13A,

Fig. 14A is a sectional side view of the device according to Fig. 10, showing the device in a position where a tool bit has been inserted past the locking ball,

Fig. 14B is a section along line 4-4 of Fig. 14A,

Fig. 15A is a sectional side view of the device according to Fig. 10, showing the device in a position where a tool bit has been inserted further past the locking ball compared to Fig. 14A,

Fig. 15B is a section along line 5-5 of Fig. 15A,

Fig. 16A is a sectional side view of the device according to Fig. 10, showing the device in a position where a tool bit has been inserted so the locking ball engages the groove in the tool bit,

Fig. 16B is a section along line 6-6 of Fig. 16A,

Fig. 17A is a sectional side view of the device according to Fig. 10, showing the device in a position where the sleeve is pushed back to allow the removal of the tool bit,

Fig. 17B is a section along line 7-7 of Fig. 17A,

Fig. 17C is a section along line 7-7 of Fig. 17A, showing pairs of depressor displacement balls used in a preferred embodiment of the embodiment shown in Fig. 10,

Fig. 18 is a sectional side view of a device according to a third embodiment of the invention, showing the device in a position where a tool bit is being inserted,

Fig. 19 is a sectional side view of the device according to Fig. 18, showing the device in a position where a tool bit is fully inserted,

Fig. 20 is an exploded partially sectioned view of the device according to Fig. 18, showing the device in a position where a tool bit is being inserted,

Fig. 21 is a sectional side view of a device according to a fourth embodiment of the invention, showing the device in a position where a tool bit is being inserted,

Fig. 22 is a sectional side view of the device according to Fig. 21, showing the device in a position where a tool bit is fully inserted,

Fig. 23 is a sectional side view of the device according to Fig. 21, showing the device in a position where a tool bit is being removed,

Fig. 24 is a sectional side view of a device according to a fifth embodiment of the invention, showing the device in a position where a tool bit is being inserted,

Fig. 25 is a sectional side view of the device according to Fig. 24, showing the device in a position where a tool bit is fully inserted,

Fig. 26 is a sectional side view of the device according to Fig. 24, showing the device in a position where a tool bit is being removed,

Fig. 27 is a sectional side view of a device according to a sixth embodiment of the invention, showing the device in a position where a tool bit is fully inserted,

Fig. 28 is a sectional side view of the device according to Fig. 27, showing the device in a position where a tool bit is being removed,

Fig. 29 is a sectional side view of a device according to a seventh embodiment of the invention, showing the device in a position where a tool bit is being inserted,

Fig. 30 is a sectional side view of the device according to Fig. 29, showing the device in a position where a tool bit contacts the tilting washer,

Fig. 31 is a sectional side view of the device according to Fig. 29, showing the device in a position where a tool bit is fully inserted,

Fig. 32 is a sectional side view of the device according to Fig. 29, showing the device in a position where a tool bit is being removed,

Fig. 33A shows a top view of a first embodiment of the tilting washer according to Fig. 29,

Fig. 33B shows a top view of a second embodiment of the tilting washer according to Fig. 29,

Fig. 34A is a perspective elevational side view of the connector means according to Fig. 29,

Fig. 34B is a side view of the connector means according to Fig. 29,

Fig. 35 is a sectional side view of a device according to an alternative to the seventh embodiment of the invention,

Fig. 36A is a side view of a washer hold down means according to Fig. 35,

Fig. 36B is another side view of a washer hold down means according to Fig. 35,

Fig. 37A is a side view of a connecting means according to Fig. 35,

Fig. 37B is another side view of a connecting means according to Fig. 35,

Fig. 38A is a sectional side view of an eight embodiment of the invention, showing the device with an inserted tool bit,

Fig. 38B is a sectional side view of the device according to Fig. 38A, showing the device when the tool bit is released,

Fig. 39A is a sectional side view of a ninth embodiment of the invention, showing the device with an inserted tool bit,

Fig. 39B is a sectional side view of the device according to Fig. 39A, showing the device when the tool bit is released,

Fig. 39C is a sectional side view of a tenth embodiment of the invention, showing the device with an inserted tool bit,

Fig. 40A is a sectional side view of an eleventh embodiment of the invention, showing the device with an inserted tool bit,

Fig. 40B is a sectional side view of the device according to Fig. 40A, showing the device when the tool bit is released,

Fig. 40C is a sectional side view of the device according to Fig. 40A, showing the device when the tool bit is inserted,

Fig. 41A is a sectional side view of a device according to a twelfth embodiment of the invention, showing the device in a position where a tool bit is in a position to be inserted the holder,

Fig. 41B is a sectional side view of the device according to Fig. 41A, showing the device when the tool bit is in an intermediate position during insertion,

Fig. 41C is a sectional side view of the device according to Fig. 41A, showing the device when the tool bit makes contact with the transition ball,

Fig. 41D is a sectional side view of the device according to Fig. 41A, showing the device when the tool bit is fully seated in the holder,

Fig. 41E is a sectional side view of the device according to Fig. 41A, showing the device when the tool bit is beginning to be removed from the holder by releasing the locking ball when the sleeve is pressed towards the tool bit,

Fig. 41F is a sectional side view of the device according to Fig. 41A, showing the device when the tool bit is further removed from the holder and loses contact with the transition ball,

Fig. 41G is a sectional side view of the device according to Fig. 41A, showing the device when the tool bit is fully removed from the holder,

Fig. 42A is a sectional side view of a device according to a thirteenth embodiment of the invention, showing the device in a position where a tool bit is being inserted into the holder,

Fig. 42B is a sectional side view of the device according to Fig. 42A, showing the device when the tool bit is further pressed into the holder,

Fig. 42C is a sectional side view of the device according to Fig. 42A, showing the device when the tool bit is locked by the locking ball,

Fig. 42D is a sectional side view of the device according to Fig. 42A, showing the device when the sleeve is in its locking position, to block the movement of the locking ball,

Fig. 43A is a sectional side view of the main body of the device according to Fig. 42A,

Fig. 43B is a side view of the main body of the device according to Fig. 43A,

Fig. 43C is a front view from the tool bit insertion side of the main body of the device according to Fig. 43A,

Fig. 43D is a rear view from the device mounting side of the main body of the device according to Fig. 43A,

Fig. 44A is a sectional side view of the sleeve of the device according to Fig. 42A,

Fig. 44B is a side view of the sleeve of the device according to Fig. 44A,

Fig. 44C is a front view from the tool bit insertion side of the sleeve of the device according to Fig. 44A,

Fig. 44D is a rear view from the tool bit insertion side of the sleeve of the device according to Fig. 44A,

Fig. 45 is a partially sectioned side view of a device according to a fourteenth embodiment of the invention, showing a rocker arm type locking mechanism,

Fig. 46A is a partially sectioned side view of the device according to Fig. 45, showing the sleeve pressed towards the tool bit for release of the tool bit from the holder,

Fig. 46B is a partially sectioned side view of the device according to Fig. 45, showing the sleeve pressed towards the tool bit for release of the tool bit from the holder, and the tool bit being pulled out of the holder,

Fig. 47A is a side view of the rocking arm according to Fig. 45,

Fig. 47B is a bottom view of the rocking arm according to Fig. 45,

Fig. 47C is a side view of an elongate connector means according to Fig. 45,

Fig. 47D is a partially sectioned side view of an elongate connector means according to Fig. 45,

Fig. 47E is a bottom view of an elongate connector means according to Fig. 45,

Fig. 47F is a top view of an elongate connector means according to Fig. 45,

Fig. 48A is a partially sectioned side view of a device according to a fifteenth embodiment of the invention, showing a dual cylinder type locking mechanism,

Fig. 48B is a partially sectioned side view of the device according to Fig. 48A, showing the sleeve pressed towards the tool bit for release of the tool bit from the holder,

Fig. 48C is a partially sectioned side view of the device according to Fig. 48A, showing the sleeve pressed towards the tool bit for release of the tool bit from the holder, and the tool bit being pulled out of the holder,

Fig. 49A is a side view of a transition cylinder according to Fig. 48A,

Fig. 49B is a bottom view of the transition cylinder according to Fig. 48A,

Fig. 50A is a side view of a locking cylinder according to Fig. 48A,

Fig. 50B is a bottom view of the locking cylinder according to Fig. 48A,

Fig. 51A is a side view of an elongate connector means according to Fig. 48A,

Fig. 51B is a partially sectioned side view of an elongate connector means according to Fig. 48A,

Fig. 51C is a bottom view of an elongate connector means according to Fig. 48A,

Fig. 51D is a top view of an elongate connector means according to Fig. 48A,

Fig. 52A is a side view of a first embodiment of a double-ended tool bit, having a drill bit at one end and a screwdriving bit at the other end, and having an annular groove retention means,

Fig. 52B is a side view of a second embodiment of a double-ended tool bit, having a drill bit at one end and a screwdriving bit at the other end, and having a plurality of circular detents retention means,

Fig. 52C is a side view of a third embodiment of a double-ended tool bit, having a drill bit at one end and a screwdriving bit at the other end, and having a plurality of transversely running elongate recessed retention means,

Fig. 52D is a side view of a fourth embodiment of a double-ended tool bit, having a drill bit at one end and a screwdriving bit at the other end, and having a plurality of slotted corner retention means,

Fig. 53A is a partially sectioned side view of a device according to a sixteenth embodiment according to the invention, showing a pin type locking mechanism, with the double-ended tool bit in a position to be inserted into the holder,

Fig. 53B is a partially sectioned side view of the device of Fig. 53A, showing the double-ended tool bit in a position inserted into the holder up until the collar of the tool bit contacts the locking pin,

Fig. 53C is a partially sectioned side view of the device of Fig. 53A, showing the double-ended tool bit in a position inserted into the holder so that the locking pin slides on top of the collar of the tool,

Fig. 53D is a partially sectioned side view of the device of Fig. 53A, showing the double-ended tool bit in a position inserted into the holder and the locking pin is in a position to almost slide off the outer end of the collar of the tool bit,

Fig. 53E is a partially sectioned side view of the device of Fig. 53A, showing the double-ended tool bit in a position inserted fully into the holder up until the collar of the tool bit is locked by the locking pin,

Fig. 54A is a partially sectioned side view of the device of Fig. 53A, showing the double-ended tool bit fully inserted into the holder,

Fig. 54B is a partially sectioned side view of the device of Fig. 53A, showing the sleeve pushed forwards to unlock the locking pin and the double-ended tool bit in a position where the locking pin can begin travelling over the collar of the tool bit,

Fig. 54C is a partially sectioned side view of the device of Fig. 53A, showing the locking pin sliding on top of the collar of the tool,

Fig. 54D is a partially sectioned side view of the device of Fig. 53A, showing the locking pin in a position to almost slide off the inner end of the collar of the tool bit,

Fig. 54E is a partially sectioned side view of the device of Fig. 53A, showing the double-ended tool bit in a position where the locking pin has fully released the tool bit and the tool bit is ready to be removed from the holder,

Fig. 55A is a side view of an elongate connector means according to Fig. 53A,

Fig. 55B is a partially sectioned side view of an elongate connector means according to Fig. 53A,

Fig. 55C is a bottom view of an elongate connector means according to Fig. 53A,

Fig. 55D is a top view of an elongate connector means according to Fig. 53A,

Fig. 56A is a side view of an outer sleeve according to Fig. 53A,

Fig. 56B is a partially sectioned side view of the sleeve according to Fig. 53A,

Fig. 56C is a top view of the sleeve according to Fig. 53A,

Fig. 57A is a side view of a locking pin according to Fig. 53A,

Fig. 57B is a top view of the locking pin according to Fig. 53A,

Fig. 58A is a top view of a locking pin spring washer according to Fig. 53A,

Fig. 58B is a side view of a locking pin spring washer according to Fig. 53A,

Fig. 59 is a partially sectioned side view of a device according to a variation of the seventh embodiment of the invention, showing the device in a position where a double-ended tool bit is fully inserted in the holder,

Fig. 60A is a partially sectioned side view of a device according to a variation of the fourteenth embodiment of the invention, showing the device in a position where a single-ended tool bit is being inserted,

Fig. 60B is a partially sectioned side view of the device of Fig. 60A, showing the device in a position where a single-ended tool bit is being inserted and contacts the rocker arm,

Fig. 60B is a partially sectioned side view of the device of Fig. 60A, showing the device in a position where a single-ended tool bit is being inserted and contacts the rocker arm,

Fig. 60C is a partially sectioned side view of the device of Fig. 60A, showing the device in a position where a single-ended tool bit is being inserted has pivoted the rocker arm,

Fig. 60D is a partially sectioned side view of the device of Fig. 60A, showing the device in a position where a single-ended tool bit is fully inserted and the rocker arm locks into the groove of the tool bit,

Fig. 60E is a partially sectioned side view of the device of Fig. 60A, showing the device in a position where a single-ended tool bit is fully inserted and the sleeve is moved towards the tool bit insertion end of the holder,

Fig. 61A is a partially sectioned side view of the device of Fig. 60A, showing the device in a position where a single-ended tool bit is fully inserted in the holder,

Fig. 61B is a partially sectioned side view of the device of Fig. 60A, showing the device in a position where a single-ended tool bit is fully inserted and the sleeve is moved towards the tool holder end of the holder, releasing the rocker arm from the tool bit groove,

Fig. 61C is a partially sectioned side view of the device of Fig. 60A, showing the device in a position where a single-ended tool bit is being removed and the rocker arm is sliding on the tool bit,

Fig. 61D is a partially sectioned side view of the device of Fig. 60A, showing the device in a position where a single-ended tool bit is fully removed from the holder,

Fig. 61E is a partially sectioned side view of the device of Fig. 60A, showing the device in a position where a single-ended tool bit is fully removed from the holder, and the sleeve is moved to its fully biased position towards the tool bit end of the holder,

Fig. 62A is a partially sectioned side view of a connector means of the device of Fig. 60A,

Fig. 62B is a side view of a rocker arm of the device of Fig. 60A,

Fig. 62C is a sectioned side view of a sleeve of the device of Fig. 60A,

Fig. 63A is a partially sectioned side view of a seventeenth embodiment of a device according to the invention,

Fig. 63B is a side view of a fifth embodiment of double-ended tool bit suitable for use with a device according to Fig. 63A,

Fig. 63C is a side view of a sixth embodiment of double-ended tool bit suitable for use with a device according to Fig. 63A,

Fig. 64A is a partially sectioned side view of the device according to the seventh embodiment of the invention as shown in Fig. 29, when used with a first embodiment of a drill bit,

Fig. 64B is a side view of the device according to Fig. 64A,

Fig. 65A is a side view of a first embodiment of a drill bit suitable for use with the device according to Fig. 64A,

Fig. 65B is an end view of the drill bit as shown in Fig. 65A,

Fig. 66A is a side view of a second embodiment of a drill bit suitable for use with the device according to Fig. 64A,

Fig. 66B is an end view of the drill bit as shown in Fig. 66A,

Fig. 67A is a side view of a third embodiment of a drill bit suitable for use with the device according to Fig. 64A,

Fig. 67B is an end view of the drill bit as shown in Fig. 67A,

Fig. 68A is a side view of a fourth embodiment of a drill bit suitable for use with the device according to Fig. 64A,

Fig. 68B is an end view of the drill bit as shown in Fig. 68A,

Fig. 69A is a side view of a fifth embodiment of a drill bit suitable for use with the device according to Fig. 64A,

Fig. 69B is an end view of the drill bit as shown in Fig. 69A,

Fig. 70A is a side view of a sixth embodiment of a drill bit suitable for use with the device according to Fig. 64A,

Fig. 70B is an end view of the drill bit as shown in Fig. 70A,

Fig. 71A is a side view of a seventh embodiment of a drill bit suitable for use with the device according to Fig. 64A,

Fig. 71B is an end view of the drill bit as shown in Fig. 71A,

Fig. 72A is a side view of an eighth embodiment of a drill bit suitable for use with the device according to Fig. 64A,

Fig. 72B is an end view of the drill bit as shown in Fig. 72A,

Fig. 73 is a partially sectioned side view of an eighteenth embodiment of a device according to the invention,

Fig. 74A is a partially sectioned side view of a nineteenth embodiment of a device according to the invention,

Fig. 74B is a perspective side view of a wave spring as used in the device shown in Fig. 74A,

Fig. 74C is a side view of a wave spring as used in the device shown in Fig. 74A,

Fig. 74D is an end view of a wave spring as used in the device shown in Fig. 74A,

Fig. 75A is a partially sectioned side view of a further embodiment of the invention, showing a notched drill bit shank ready to be inserted in a holder according to the invention,

Fig. 75B is a partially sectioned view of the device of Fig. 75A, showing the drill bit fully inserted into the holder,

Fig. 76 is a view showing that the body can be in two pieces, if desired, namely a back housing and a nose piece.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to Figs. 1 and 2, a holder **100**, for example mounted on a power tool or a hand tool for securely holding any one of a plurality of exchangeable tool bits **300**, comprises an elongate connector means **110** and an outer sleeve **180**. The connector means is attachable to a power tool or a hand tool via a tool mount **10**.

The connector means **110** has a central longitudinal hole **120**, which has a cross-section corresponding to the cross-section of a mounting portion **310** of the tool bit. The mounting portion of the tool bit may thus be inserted into the longitudinal hole of the connector means. The tool bit further has a profiled working portion **320** opposite the mounting portion. The connector means includes a first radial hole **130** (see Fig. 6) which runs from an outside surface **140** of the connector means to the longitudinal hole. The first radial hole has a large diameter bore portion **150** at the outside surface of the connector means and a small diameter bore portion **160** at the radial hole. The first radial hole **130** further has a substantially truncated hemispherical shape, which cooperates with a substantially spherical locking ball **170** movably arranged in the first radial hole. The locking ball may, in principle, move from a position outside the longitudinal hole to a position where the locking ball protrudes a distance into the longitudinal hole **120**, but further movement is blocked because the diameter of the small diameter portion **160** of the first radial hole is smaller than the diameter of the locking ball. The locking ball **170** cooperates with a circumferential groove **330** in the tool bit **300** to lock the tool bit in place when the tool bit is fully inserted into the holder **100**.

The outer sleeve **180** is arranged to reciprocally slide over the connector means **110** between two end positions. The outer sleeve has a first end **210** facing the tool bit **300** and a second end **220** facing the power tool or hand tool tool mount **10.** A guiding bar **230** is mounted inside the outer sleeve in a radial position, i.e. transversely mounted compared to the longitudinal direction of the outer sleeve. The guiding bar is preferably

mounted in a bar groove **240** (see Fig. 5) in the outer sleeve and held in place by a guiding bar retainer **250.** The connector means **110** has a transverse through slot **260** in which the guiding bar may slide. The axial width of the through slot is larger than the radial width of the through slot, and the axial width defines the stroke of the outer sleeve **180.** The guiding bar **230** may thus slide between two end positions, defined by the axial width of the through slot of the connector means.

On the inside of the first end **210** of the outer sleeve, a stepped recess **270** is arranged. The stepped recess preferably has a first large diameter part **280** (see Fig. 5) and a second smaller diameter part **290** (see Fig. 5). Both the first part **280** and the second part **290** have diameters which are larger than the outer diameter of the connector means **110.** A locking ball depressor **190** is arranged to reciprocally slide inside the first large diameter part of the stepped recess. The depressor preferably is formed as a ring having an inner diameter which is slightly larger than the outer diameter of the connector means **110** and an outer diameter which is slightly smaller than the diameter of the first large diameter part **280** of the stepped recess **270.** A depressor biasing means **200**, for example a coil spring, is arranged to bias the depressor against the step between the first large diameter part and the second small diameter part of the stepped recess. A first end cap **340** is arranged at the first end **210** of the outer sleeve **180** to hold the depressor biasing means inside the stepped recess **270.** The first end cap is preferably ring formed, having an outer diameter which is slightly larger than the larger diameter of the stepped recess **270**, thus enabling the first end cap to be press fit into the stepped recess, and an inside diameter which is slightly larger than the outer diameter of the connector means **110**, thus enabling the connector means to protrude through the first end cap.

On the inside of the second end **220** of the outer sleeve, a second recess **350** is arranged. The second recess has a diameter which is larger than the outer diameter of the connector means **110.** A second end cap **380** is arranged at the second end of the outer sleeve **180.** The second end cap is preferably ring formed, having an outer diameter which is slightly larger than the diameter of the second recess **350**, thus

enabling the second end cap to be press fit into the second recess, and an inside diameter which is slightly larger than the outer diameter of the connector means **110**, thus enabling the connector means to protrude through the second end cap. A sleeve biasing means **360** is arranged between the guiding bar retainer **250** and a sleeve retainer means **370** to bias the outer sleeve in a direction away from the tool mount **10**. The sleeve retainer means is arranged on the part of the connector means **110** which faces the tool mount and is preferably shaped as a ring which fits in a retainer groove on the connector means.

As shown in Fig. 1, the tool bit **300** is locked in the longitudinal hole **120** of the connector means **110** by the locking ball **170.** The locking ball is prevented from moving from its position, protruding into the longitudinal hole, by the locking ball depressor **190.**

Fig. 3 shows a device according to the invention, without an inserted tool bit. The outer sleeve **180** is pressed to its position furthest away from the tool mount **10** by the sleeve biasing means **360.** In this position, there is enough space inside the stepped recess **270**, between the locking ball and the locking ball depressor **190**, to allow the locking ball **170** to freely move inside the first radial hole **130.** Thus, a tool bit (not shown) may be inserted into the longitudinal hole **120** of the connector means **110** without encountering resistance from the locking ball. When the tool bit is inserted, the mounting portion **310** of the tool bit hits the guiding bar **230**, thus pressing the outer sleeve **180**, against the biasing force of the sleeve biasing means **360**, towards the tool mount **10.** As the outer sleeve is pressed towards the hand tool, the locking ball depressor **190** will also be pressed towards the hand tool by the depressor biasing means **200.** The locking ball depressor will thus slide over the locking ball and block the ball in its movement in the first radial hole **130**, effectively locking the tool bit in the longitudinal hole **120.**

To release the tool bit **300** from the longitudinal hole **120**, the outer sleeve **180** will have to be fully pressed towards the tool mount **10** against the biasing force of the sleeve biasing means **360**, as shown in Fig. 4. The locking ball depressor **190** is then forced by

the depressor biasing means to slide over the locking ball **170**, thus releasing the locking ball. The tool bit may thus be removed without excessive force.

In Fig. 5, the outer sleeve **180** is shown alone. The first end **210** facing the tool bit **300**, the second end **220** facing the tool mount (not shown), the guiding bar groove **240** and the stepped recess **270**, arranged on the inside of the first end of the outer sleeve, with its first large diameter part **280** and second smaller diameter part **290**, are shown as previously described.

In Figs. 6 and 7, the connector means **110** is shown. The longitudinal hole **120**, the transverse slot **260** and the first radial hole **130**, with its large diameter bore portion **150** at the outside surface of the connector means and the small diameter bore portion **160** at the longitudinal hole, are shown as previously described. Also the sleeve retainer means **370** is shown, although this is preferably not manufactured as an integral part of the connector means **110.**

In Fig. 8, the locking ball depressor **190** is shown. The depressor is advantageously shaped as a ring having bevelled inner edges to facilitate the depressor sliding over the locking ball (not shown).

In Figs. 9A and 9B, the guiding bar **230** is shown. The guiding bar is advantageously substantially rectangular with rounded short edges. The thickness of the guiding bar corresponds to the width of the guiding bar groove of the outer sleeve (not shown).

A second embodiment of the invention is shown in Figs. 10 to 17B. In this case, the holder **100** comprises an elongate connector means **110'** and an outer sleeve **180'**. The connector means is attachable to the handle (not shown) of a power tool or a hand tool via a tool mount **10**. The connector means **110'** has a longitudinal hole **120**, which has a cross-section corresponding to the cross-section of the mounting portion of the tool bit. The mounting portion of the tool bit may thus be inserted into the longitudinal hole of the connector means. The connector means includes a first radial hole **130**, which

cooperates with a substantially spherical locking ball **170** movably arranged in the radial hole, as has been described in connection with the first embodiment of the invention. The locking ball **170** cooperates with a circumferential groove in the tool bit to lock the tool bit in place when the tool bit is fully inserted into the holder **100**. The outer sleeve **180'** is arranged to reciprocally slide over the connector means **110'** between two end positions. The outer sleeve has a first end **210'** facing the tool bit and a second end **220'** facing the hand tool **10.**

The sleeve **180'** has three inside portions of different diameters, ranging from a large diameter portion **410** at the second end **210'** of the sleeve, a small diameter portion **430** at the first end **210'** of the sleeve and a medium diameter portion **420** arranged between the large diameter portion and the small diameter portion of the sleeve. A locking ball depressor **190** is arranged to reciprocally slide inside the large diameter portion of the sleeve. The depressor preferably is formed as a ring having an inner diameter which is slightly larger than the outer diameter of the connector means **110'** and an outer diameter which is slightly smaller than the diameter of the large diameter portion **410** of the sleeve **180'.** A depressor biasing means **360'**, for example a coil spring, is arranged to bias the depressor against the step between the large diameter portion and the medium diameter portion of the sleeve.

A first depressor displacement ball **390** is arranged in a second radial hole **395.** The second radial hole has a geometry corresponding to the first radial hole **130**, restricting the movement of the first depressor displacement ball to a movement corresponding to that of the locking ball **170**. A second depressor displacement ball **400** is arranged in a third radial hole **405.** The third radial hole has a geometry corresponding to the first radial hole **130**, restricting the movement of the second depressor displacement ball to a movement corresponding to that of the locking ball **170**. The respective radii of the first, second and third radial holes are substantially the same. The second radial hole **395** is arranged at a distance, in the longitudinal direction of the elongate connector means **110'**, from the first radial hole **130** corresponding to approximately half the radius of the radial holes and the third radial hole **405** is arranged at a distance, in the

longitudinal direction of the elongate connector means **110'**, from the second radial hole **395** corresponding to approximately half the radius of the radial holes. The radial holes are thus circumferentially disposed along the outside of the elongate connector means **110'** with a certain staggering corresponding to half the radius of the radial holes. Advantageously, the first and second depressor displacement balls, **390** and **400**, respectively, are arranged in diametrically opposed pairs, so that two first depressor displacement balls are used and two second depressor displacement balls are used. In this way, a smoother and more reliable movement of the depressor **190** is achieved.

Referring to Figs. 11A and 11B, when the tool bit **300** is inserted into the elongate connector means **110'**, the mounting portion **310** of the tool bit hits the first depressor displacement ball **390**, which is pressed out of the second radial hole **395**. The first depressor displacement ball thus presses against the locking ball depressor **190**, forcing the locking ball depressor towards the tool mount **10**.

When the tool bit **300** is pressed down further, as shown in Figs. 12A and 12B, the mounting portion **310** of the tool bit hits the second depressor displacement ball **400**, which is pressed out of the third radial hole **405**. The second depressor displacement ball thus presses against the locking ball depressor **190**, forcing the locking ball depressor further towards the tool mount **10**.

The locking ball depressor **190** is now in a position over the locking ball **170**. Further movement downwards of the tool bit **300** will cause the mounting portion **310** of the tool bit to hit the locking ball, which will be pressed out of the first radial hole **130**, as shown in Figs. 13A and 13B. The locking ball **170** will thus press against the locking ball depressor **190**, forcing the locking ball depressor still further towards the tool mount **10**, to a position of the locking ball depressor which allows the locking ball to completely exit the longitudinal hole **120** as the tool bit **300** is pressed further down, as shown in Figs. 14A and 14B.

In Figs. 15A and 15B, the position of the device just before the locking ball **170** enters the circumferential groove **330** in the tool bit **300** is shown.

In Figs. 16A and 16B, the tool bit **300** is fully inserted and the locking ball **170** is fully seated into the circumferential groove **330** in the tool bit **300**. The locking ball depressor **190** is now in a position over the locking ball **170,** which effectively locks the locking ball in place. The tool bit is thus held in the holder.

To release the tool bit **300** from the holder **100**, the sleeve **180'** is pulled back towards the tool mount **10** to move the locking ball depressor **190** from the position over the locking ball **170**, as is shown in Figs. 17A and 17B. The locking ball is thus free to move outwards in the first radial hole **130**, and is not blocking the removal of the tool bit. The tool bit may thus be removed from the holder.

The first depressor displacement ball **390** preferably is arranged opposite a third depressor displacement ball **500** and the second depressor displacement ball **400** preferably is arranged opposite a fourth depressor displacement ball **600**, as shown in Fig. 17C. The third depressor displacement ball is arranged in a fourth radial hole (not shown). The fourth radial hole has a geometry corresponding to the first radial hole **130**, restricting the movement of the third depressor displacement ball **500** to a movement corresponding to that of the locking ball **170**. The fourth radial hole is located 180 degrees opposite the first radial hole **395** in the connecting means **110**. The fourth depressor displacement ball **600** is arranged in a fifth radial hole (not shown). The fifth radial hole has a geometry corresponding to the first radial hole **130**, restricting the movement of the fourth depressor displacement ball to a movement corresponding to that of the locking ball **170**. The fifth radial hole is located 180 degrees opposite the second radial hole **405** in the connecting means **110**. By using two opposed pairs of depressor displacement balls, a smoother movement of the depressor **190** is provided and the risk of the depressor tilting inside the sleeve **180'**, when the depressor displacement balls press the depressor towards the tool mount **10,** is minimized.

A third embodiment of the invention is shown in Figs. 18 to 20. In this case, the holder **100** comprises an elongate connector means **110"** and an outer sleeve **180"**. The connector means is attachable to a power tool or hand tool via a tool mount **10'**. The connector means **110"** has a longitudinal hole **120'**, which has a cross-section corresponding to the cross-section of the mounting portion of the tool bit. The mounting portion of the tool bit may thus be inserted into the longitudinal hole of the connector means. The connector means includes a fourth radial hole **131**, which cooperates with a locking lever **175** arranged to pivot back and forth inside the fourth radial hole. The locking lever pivots around a pivot pin (not shown), which is arranged in pivot holes **130'** in the connecting means **110"**. The locking lever **175** cooperates with the circumferential groove in the tool bit to lock the tool bit in place when the tool bit is fully inserted into the holder **100**. The outer sleeve **180"** is arranged to reciprocally slide over the connector means **110"** between two end positions.

The sleeve **180"** has a first inner circumferential recess **181** and a second inner circumferential recess **182**. The first circumferential recess cooperates with and manoeuvres the locking lever between two end positions inside the fourth radial hole **131**, when the sleeve slides between its two end positions. The second circumferential recess **182** cooperates with a sleeve stop **185** in a way which will be described later. A sleeve biasing means **200'**, for example a coil spring, is arranged to bias the sleeve **180"** away from the tool mount **10'**.

The connector means **110"** further has a circumferential slit **115** for holding the sleeve stop **185** in position. The sleeve stop is preferably a washer-shaped disc with a slit to allow it to be compressed for mounting in the second inner circumferential recess **182**. The second inner circumferential recess has a length in the longitudinal direction of the sleeve **180"**, which defines the throw of the sliding motion of the sleeve relative the connector means. In each end position of the throw, the sleeve stop will contact the respective side surface of the second inner circumferential recess to thereby prevent further movement of the sleeve. When a tool bit **300** is inserted into the longitudinal hole **120'**, the locking lever **175** end which contacts the tool bit is pushed towards the sleeve

180". After the tool bit is fully seated into the longitudinal hole, the locking lever **175** end which contacts the tool bit is free to pivot into the circumferential groove **330** in the tool bit. The sleeve biasing means **200'** is arranged to transmit its spring force to the sleeve via the end of the locking lever **175** which contacts the first inner circumferential recess **181**, thereby further facilitating the pivoting of the lever into the circumferential groove.

To release the tool bit **300**, the sleeve **180"** is manually slid away from the tool mount, whereby the locking lever **175** is forced to pivot out of the circumferential groove **330**. The tool bit is now free to be removed from the longitudinal hole **120'**.

A fourth embodiment of the invention is shown in Figs. 21 to 23. In this case, the holder **100** comprises an elongate connector means **110'''** and an outer sleeve **184**. The connector means is attachable to a power tool or hand tool via a tool mount **10"**. The connector means **110'''** has a longitudinal hole **120"**, which has a cross-section corresponding to the cross-section of the mounting portion of the tool bit. The connector means includes a first radial hole **130**, which cooperates with a substantially spherical locking ball **170** movably arranged in the radial hole, as has been described in connection with the first embodiment of the invention. The locking ball **170** cooperates with the circumferential groove in the tool bit to lock the tool bit in place when the tool bit is fully inserted into the holder **100**. The outer sleeve **184** is arranged to reciprocally slide over the connector means **110'''** between two end positions, and has a uniform inner diameter, except for a depressor stop **191** arranged on the inside of the sleeve and protruding from the sleeve. A locking ball depressor **190'** is arranged to reciprocally slide inside the sleeve. The depressor preferably is formed as a ring having an inner diameter which is slightly larger than the outer diameter of the connector means **110'''** and an outer diameter which is slightly smaller than the inner diameter of the sleeve. A depressor biasing means **200"**, for example a coil spring, is arranged to bias the depressor away from the handle. A third end cap **340'** is arranged at the end of the outer sleeve **184** which faces the tool bit **300**, to seal the inside of the sleeve during normal use. The third end cap is preferably ring formed, having an outer diameter which is substantially the same as the outer diameter of the sleeve, and an inside diameter which

is slightly larger than the outer diameter of the connector means **110"**, thus enabling the connector means to protrude through the first end cap. The third end cap further has an annular protrusion **341**, arranged on the side of the third end cap which faces the sleeve. The annular protrusion is arranged to fit inside the sleeve **184**, when the sleeve is pressed against the third end cap. The depressor **190'** is pressed against the locking ball depressor stop **191** by the depressor biasing means **200"**.

In Fig. 21, a tool bit **300** is being inserted into the longitudinal hole **120"**. The inserted end of the tool bit will push the locking ball **170** radially outwards from the longitudinal hole in its radial hole (as has been described in connection with Figs. 1 and 6). The locking ball will then push the depressor **190'** towards the handle, because of the bevelled edge of the depressor facing the locking ball. This allows the locking ball **170** to protrude sufficiently out of the radial hole so that the tool bit **300** may be fully inserted into the longitudinal hole **120"**. As the tool bit is fully inserted, the locking ball is free to be seated in the circumferential groove of the tool bit by the depressor **190'** and the sleeve **184** being biased away from the handle by the sleeve biasing means **200"**. Thus, the tool bit will be securely locked in position, as shown in Fig. 22.

To release the tool bit **300**, the sleeve **184** is slid towards the tool mount (not shown), whereby the depressor **190'** is made to slide in the same direction by the locking ball depressor stop **191**. The locking ball **170** is thus free to move in the radial hole, thus freeing the tool bit which may be removed from the longitudinal hole **120"**, as shown in Fig. 23.

A fifth embodiment of the invention is shown in Figs. 24 to 26. In this case, the holder **100** comprises an elongate connector means **114** and an outer sleeve **184'**. The connector means is attachable to a power tool or hand tool (not shown) via a tool mount **10'''**. The connector means **114** has a longitudinal hole **120'''**, which has a cross-section corresponding to the cross-section of the mounting portion of the tool bit. The connector means includes a first radial hole **130**, which cooperates with a substantially spherical locking ball **170** movably arranged in the radial hole, as has been described in

connection with the first embodiment of the invention. The locking ball **170** cooperates with the circumferential groove in the tool bit to lock the tool bit in place when the tool bit is fully inserted into the holder **100**. The outer sleeve **184'** is arranged to reciprocally slide over the connector means **114** between two end positions, and has a stepped inside diameter, having a smaller diameter part facing the tool mount and a larger diameter part facing the tool bit. A bevelled transition **186** is arranged between the two diameter parts. The bevelled transition functions similarly to the depressor described for earlier embodiments. A sleeve biasing means **360'**, for example a coil spring, is arranged to bias the sleeve **184'** away from the tool mount. The bevelled transition **186** is pressed against the locking ball **170** by the sleeve biasing means **360'**. The sleeve biasing means is held in place by a biasing means stop **361** fastened on the tool mount **10'''**.

In Fig. 24, a tool bit **300** is being inserted into the longitudinal hole **120'''**. The inserted end of the tool bit will push the locking ball **170** radially outwards from the longitudinal hole in its radial hole (as has been described in connection with Figs. 1 and 6). The locking ball will then push the bevelled transition **186** towards the tool mount, and thus the whole sleeve **184'**. This allows the locking ball **170** to protrude sufficiently out of the radial hole so that the tool bit **300** may be fully inserted into the longitudinal hole **120'''**. As the tool bit is fully inserted, the locking ball is free to be seated in the circumferential groove of the tool bit by the sleeve **184'** being biased away from the handle by the sleeve biasing means **360'**. Thus, the tool bit will be securely locked in position, as shown in Fig. 25.

To release the tool bit **300**, the sleeve **184'** is slid towards the tool mount (not shown), whereby the bevelled transition **186** no longer blocks the locking ball **170** from moving in the radial hole. The tool bit may thus be removed from the longitudinal hole **120'''**, as shown in Fig. 26.

A sixth embodiment of the invention is shown in Figs. 27 and 28. In this case, the holder **100** comprises an elongate connector means **111** and an outer sleeve **187**. The connector means is attachable to a power tool or hand tool (not shown) via a tool mount

10'''. The connector means **111** has a longitudinal hole **121**, which has a cross-section corresponding to the cross-section of the mounting portion of the tool bit. The connector means includes a first radial hole **130**, which cooperates with a substantially spherical locking ball **170** movably arranged in the radial hole, as has been described in connection with the first embodiment of the invention. The locking ball **170** cooperates with the circumferential groove in the tool bit to lock the tool bit in place when the tool bit is fully inserted into the holder **100**. The outer sleeve **187** is arranged to reciprocally slide over the connector means **111** between two end positions, and has a stepped inside diameter, having a medium diameter part **188** facing the handle and a larger diameter part **189** facing the tool bit with a smaller diameter part between them. A spherical recess **172** is arranged in the smaller diameter part, having a shape corresponding to the spherical shape of the locking ball **170**. A sleeve biasing means **200'''**, for example a coil spring, is arranged in the larger diameter part, to bias the sleeve **187** away from the tool mount and thereby to slide the spherical recess away from the locking ball. An annular biasing means stop **115'** is arranged at the end of the connecting means **111** which faces the tool bit **300**, to prevent the sleeve biasing means from falling out of the sleeve and to provide a support surface for the biasing means. An angled channel **112** is arranged in the connecting means **111** between the radial hole **130** and the end of the connecting means which faces the handle. The angled channel and the radial hole are connected by a connecting channel **113,** arranged on the side of the connecting means which faces the sleeve. An elongate rigid arm **171** is arranged in the angled channel **112** so that a rounded end **173** of the rigid arm protrudes into the connecting channel. When no tool bit is inserted into the longitudinal hole **121** and the sleeve **187** is biased to its position closest to the tool mount, the rigid arm **171** is free to move in the angled channel, but cannot move out of the angled channel because the sleeve **187** and the bottom of the longitudinal hole **121** blocks its movement. The rounded end **173** is lodged in or near the spherical recess **172,** in this position of the sleeve. When a tool bit **300** is to be inserted into the holder **100**, the sleeve **187** is in a position as shown in Fig. 28, with the rounded end **173** of the rigid arm **171** blocking further movement of the sleeve towards the tool mount **10'''**. When the inserted end of the tool bit **300** contacts the rigid arm **171**, the arm is tilted away from a stop ridge **183** arranged on the inside of the

sleeve **187**, so that the sleeve no longer is blocked in its biased movement away from the tool bit by the rigid arm locking against the stop ridge. Thus, the sleeve will slide away from the tool bit **300** and the locking ball **170** will be pressed into the circumferential groove of the tool bit and the tool bit will be securely locked in position, as shown in Fig. 28. As the tool bit is fully inserted, the locking ball is free to be seated in the circumferential groove of the tool bit by the sleeve **187** being biased away from the tool mount by the sleeve biasing means **200'''**.

To release the tool bit **300**, the sleeve **187** is slid away from the tool mount **10'''**, whereby a smaller diameter part **198** of the sleeve **187** no longer blocks the locking ball **170** from moving in the radial hole. The rounded end **173** of the rigid arm **171** is tilted against the stop ridge **183** arranged on the inside of the sleeve **187**, so that the sleeve is blocked in its biased movement away from the tool bit by the rigid arm locking against the stop ridge. The spherical recess **172** is thus located directly above the locking ball **170.** The tool bit may thus be removed from the longitudinal hole **120'''**, as shown in Fig. 28.

A seventh embodiment of the invention is shown in Figs. 29 to 34B. The connector means **110'''** comprises a longitudinal hole **122** and an opposite tool mount **10'**. The connector means further has a substantially cylindrical enlargement **123** of the longitudinal hole at the mouth of the longitudinal hole, a longitudinal slit **177** arranged along the enlargement of the longitudinal hole and a through hole **178** arranged opposite the longitudinal slit. A washer **176,** having a substantially circular circumference, a short radial protrusion **161** and a long radial protrusion **162** opposite to the first protrusion, is arranged to reciprocally slide or tilt in the enlargement **123** of the longitudinal hole **122**. The washer further has a central hole **179**, which may be hexagonal, oval or any other cross-section which corresponds to or can accommodate the cross-section of the actual tool bit **300**. The cross-section of the central hole is preferably somewhat elongate in comparison to the cross-section of the tool bit. The first protrusion is inserted into the through hole **178** and the second protrusion is inserted into the slit **177** when the device is assembled. The outer sleeve **202** is biased away from the tool mount **10'** by a sleeve biasing means **201,** which presses on the sleeve via the second protrusion **162** of the

washer **176.** The outside diameter of the washer is smaller than the inside diameter of the enlargement **123** of the longitudinal hole **122**, allowing the washer to tilt inside the enlargement. The washer **176** is prevented from tilting excessively by the first protrusion **161** cooperating with the through hole **178** and the second protrusion **162** cooperating with the slit **177**. The sleeve **202** has a profiled entry hole **203** in its end which faces away from the tool mount **10'**. The entry hole aligns the inserted tool bit **300**, which has a cross-section corresponding to the cross-section of the entry hole, the longitudinal hole **122** and the central hole **179** of the washer, with the central hole of the washer and the longitudinal hole, as is shown in Fig. 29.

In Fig. 30, the tool bit **300** has contacted the washer **176**, making the washer align itself with the outside profile of the tool bit. The washer is thus forced to tilt less, to accommodate the tool bit inside the central hole **179** of the washer, during the insertion of the tool bit. The sleeve biasing means **201** is also compressed somewhat during the insertion. When the tool bit **300** is fully inserted into the longitudinal hole **122**, as is shown in Fig. 31, the sleeve biasing means will press the second protrusion **162** of the washer **176** away from the tool holder **10'**, thus making the washer tilt as much as possible around the tool bit **300**. The tool bit is, in this way, held by the inside circumference of the central hole **179** of the washer to prevent the tool bit from being removed from the longitudinal hole **122**.

To remove the tool bit **300**, the sleeve **202** will have to be pressed towards the tool holder **10'**. The second protrusion **162** of the washer **176** will then be pressed in the same direction, making the washer tilt less. The gripping of the washer on the tool bit is thus lessened, and the tool bit may be removed.

An variation of the seventh embodiment of the invention is shown in Fig. 59. The central washer hole, the profiled entry hole of the sleeve and the longitudinal hole of the connector means all have to be dimensioned to accommodate the larger double-ended tool bit **300^{V}**. All reference numerals are the same for Fig. 59 as for Fig. 29.

In Fig. 33B, the tilting washer **176** is shown having an oval central hole **179,** the first protrusion **161** and the second protrusion **162**. In Fig. 33A, the tilting washer **176'** is shown having an elongate hexagonal central hole **179',** the first protrusion **161** and the second protrusion **162**. The second protrusion is preferably somewhat curved (not shown) to fit better between the sleeve biasing means **201** and the sleeve **202**. By selecting an appropriate central hole shape, the washer can cooperate with basically any cross-section shape tool. Thus, one holder can accommodate and securely hold tools of different shapes, for example both hex and round cross-section tools.

In Figs. 35 to 37B, an alternative embodiment to the embodiment described in Figs. 29 to 34B is shown. An outer sleeve **202'** is biased away from the tool holder **10'** by the sleeve biasing means **201'.** A washer **176,** as described above, is held in place by a washer biasing means **302**. The washer biasing means is preferably an end cap, having a protruding part **303,** which cooperates with the washer via a slanted end surface **304**. The washer biasing means **302** further has a tool bit accommodating longitudinal centre hole **301**. In Figs. 36A and 36B, the washer biasing means is shown in two side views. The connecting means **116** and tool holder **10'** are shown in Figs 37A and 37B, also in two side views. The longitudinal hole **122** of the connecting means is shown, together with the through hole **178** and the slit **177**.

In Figs. 38A and 38B, a twelfth embodiment of the invention is shown. The tool bit **300** cooperates with a connecting means **117**, which has a longitudinal hole **122** in one side. The longitudinal opening cooperates with a sleeve protrusion **129** arranged on the outer sleeve **118**. The sleeve is biased towards the tool holder **10** by a sleeve biasing means **119**. The longitudinal hole **122** has a slanting side wall **125** on the side of the opening which faces away from the tool holder. The slanting side wall has a step **124** arranged in it to cooperate with an oblong resilient means **127**. The resilient means has a first end **128** and a second end **126**, and the resilient means is tiltingly arranged adjacent the slanting side wall **125**, so that the second end is movable between one position in which the second end has entered a distance into the longitudinal hole **122** and another position in which the second end is located entirely outside the longitudinal hole. The

second end is preferably bent into a rounded shape, whilst the first end is sharply bent and fixedly secured in a hole (not shown) in the slanting side wall **125**. The rounded second end **126** cooperates with the groove on the tool bit **300** to hold the tool bit in place when the tool bit is inserted into the longitudinal hole **122** of the connecting means **117**. To release the tool bit, the sleeve **118** is pushed away from the tool holder **10**, causing the protrusion **129** to press the oblong resilient means **127** away from the tool bit **300**. The tool bit is thus free to be removed.

In Figs. 39A to 40C, different additional embodiments of the invention are shown, where a release pin mechanism is used to release the sleeve in order to align a recess in the sleeve with the locking ball, so that the tool bit may be removed.

A thirteenth and preferred embodiment of the invention is shown in Figs. 41A to 41G. In this case, the holder **100'** comprises an elongate connector means **114'** and an outer sleeve **184"**. The connector means is attachable to a power tool or hand tool (not shown) via a tool mount **10^{IV}**. The connector means **114'** has a longitudinal hole **120^{IV}**, which has a cross-section corresponding to the cross-section of the mounting portion of the tool bit. The connector means includes a first radial hole **130"**, which cooperates with a substantially spherical locking ball **170'** movably arranged in the radial hole, as has been described in connection with the first embodiment of the invention. The locking ball **170'** cooperates with the circumferential groove in the tool bit to lock the tool bit in place when the tool bit is fully inserted into the holder **100'**. The outer sleeve **184"** is arranged to reciprocally slide over the connector means **114'** between two end positions, and has a stepped inside diameter, having a smaller diameter part facing the tool mount and a larger diameter part **193** facing the tool bit. A bevelled transition **186'** is arranged between the two different diameter parts. The bevelled transition functions similarly to the depressor described for earlier embodiments in cooperation with a transition ball **194**, which will be described in detail later. A sleeve biasing means **360"**, for example a coil spring, is arranged to bias the sleeve **184"** away from the tool mount. The transition ball **194** is arranged in a transition hole **195** in the connector means **114'**. The transition hole is substantially radial, and preferably angled so that the bottom **195'** of the transition hole

is arranged further from the tool mount **10^{IV}** than the top **195"** of the transition hole. Alternatively, the transition hole is substantially perpendicular to the longitudinal hole **120^{IV}**. Thus, the transition ball **194**, which has a diameter substantially corresponding to the diameter of the transition hole **195**, is slidable between a first position at the bottom of the transition hole, to a second position protruding from the top of the transition hole. The bevelled transition **186'** is pressed against the transition ball **194** by the sleeve biasing means **360"**.

In Fig. 41A, a tool bit **300** is held in position to be inserted into the holder **100'**. The locking ball **170'** is free to slide in the radial hole **130"**, because the larger diameter part **193** of the sleeve **184"** is located adjacent the locking ball. The sleeve biasing means **360"** is pressing the sleeve and the bevelled transition **186'** against the transition ball **194**, which is thus forced to the bottom **195'** of the transition hole **195**. The sleeve is held in this position by a mechanism comprising a locking cavity **364**, which cooperates with a locking ring **362** arranged in a locking ring groove **363** arranged on the elongate connector means **114'**, to limit the stroke of the sliding movement of the sleeve along the elongate connector means **114'** in the direction towards the tool mount by the locking ring **362** blocking further movement because the locking ring contacts the edge of the locking cavity **364** (as shown in Fig. 41D), and in the direction towards the tool bit by the bevelled transition **186'** contacting the transition ball **194** in its position at the bottom of the transition hole, which protrudes enough to block the movement of the sleeve **184"** when the bevelled transition contacts the larger diameter portion of the elongate connector means (see Figs. 41A, 41B, 41C, 41E, 41F and 41G). In the latter position, the sleeve is prevented from sliding towards the tool mount, under the biasing influence of the biasing means **360"**, by the frictional forces present between the inside of the sleeve and the locking ring **362**.

As is shown in Fig. 41B, the tool bit 300 is inserted into the longitudinal hole **120^{IV}**. The inserted end of the tool bit will push the transition ball **194** radially outwards in the transition hole **195**, as shown in Fig. 41C. The transition ball **194** is pressed by the inserted end of the tool bit, from its position at the bottom of the transition hole **195**

towards the sleeve and the bevelled transition **186'**, thus pressing the sleeve towards the tool mount. A locking portion **192** of the sleeve **184"** effectively blocks the locking ball **170'** from movement in the first radial hole **130"**, locking the tool bit **300** in the longitudinal hole **120^{IV}**, see Fig. 41D.

Fig. 41E shows the situation when the sleeve **184"** is pressed towards the tool bit **300**, starting to release the locking ball **170'** by sliding the locking portion **192** of the sleeve forwards. The bevelled transition **186'** will push the transition ball **194** towards the tool bit, to thereby start pushing the tool bit out of the longitudinal hole **120^{IV}**. As is shown in Figs. 41E to 41G, the locking portion **192** of the sleeve has fully cleared the locking ball, allowing the locking ball to slide up in the first radial hole **130"** sufficiently to not protrude into the longitudinal hole **120^{IV}**. This allows the tool bit **300** to be fully removed from the longitudinal hole. The transition ball **194** is seated in the first position in the transition hole **195**, blocking any further movement of the sleeve **186"** in the direction towards the tool bit insertion hole. As soon as the tool bit has left the longitudinal hole, the locking ball can enter the longitudinal hole, as described for earlier embodiments, and thus release the sleeve **186"** for sliding towards the tool mount **10^{IV}**, but the sleeve is prevented from sliding by the frictional forces between the sleeve and the locking ring, as described above. Thus, when inserting a tool bit into the holder, these frictional forces will have to be overcome by the user pushing the tool bit into the holder with a sufficient force to release the sleeve.

Figs. 42A to 44D show a preferred fourteenth embodiment of a tool holder **100"** according to the invention. The tool holder is similar to the tool holder according to the twelfth embodiment, but incorporates an elongate connector means **114"**, for accommodating double ended tools, i.e. tools having working tool tips at both ends (for instance a drill bit in combination with a screwdriving bit). The holder functions in an identical way to the holder described in conjunction with Figs. 41A to 41G, except that the sleeve **184"'** has a locking cavity **364'**, which cooperates with a locking ring **362'** arranged in a locking ring groove **363'** arranged on the elongate connector means to limit the stroke of the sliding movement of the sleeve along the elongate connector means

114"; by either edge of the locking cavity contacting the sides of the locking ring to provide the blocking of the sleeve. Thus, the holder **100"** comprises the elongate connector means **114"** and the outer sleeve **184'''**. The connector means is attachable to a power tool or hand tool (not shown) via a tool mount **10^{V}**. The connector means **114"** has a longitudinal hole **120^{V}**, which has a cross-section corresponding to the cross-section of the mounting portion of the tool bit. The connector means includes a first radial hole **130'''**, which cooperates with a substantially spherical locking ball **170"** movably arranged in the first radial hole, as has been described in connection with the first embodiment of the invention. The locking ball **170"** cooperates with the circumferential groove **305** in the tool bit to lock the tool bit in place when the tool bit is fully inserted into the holder **100"**. The outer sleeve **184'''** is arranged to reciprocally slide over the connector means **114"** between two end positions, and has a stepped inside diameter, having a smaller diameter part **125'** facing the handle and a larger diameter part **122'** facing the tool bit. A middle diameter part **123'** is arranged between the smaller and the larger diameter parts, having a diameter which is larger than the diameter of the small diameter part but smaller than the diameter of the large diameter part. The middle diameter part is arranged to house a sleeve biasing means **360'''**. A bevelled transition **186"** is arranged between the large and middle diameter parts. The bevelled transition functions similarly to the depressor described for earlier embodiments in cooperation with a transition ball **194'**, which will be described in detail later. The sleeve **184'''** has a first end **210"** facing a tool bit insertion hole (longitudinal hole) **120^{V}**, and a second end **220"** facing the tool mount **10^{V}**, when the sleeve is mounted on the tool holder **100"**. The sleeve biasing means **360'''**, for example a coil spring, is arranged to bias the sleeve **184'''** away from the handle. The transition ball **194'** is arranged in a transition hole **197** in the connector means **114'**. The transition hole is substantially radial. Thus, the transition ball **194**, which has a diameter substantially corresponding to the diameter of the transition hole **195**, is slidable between a first position at the bottom of the transition hole, to a second position protruding from the top of the transition hole. The bevelled transition **186"** is pressed against the transition ball **194'** by the sleeve biasing means **360'''**. The longitudinal hole **120^{V}** has a large diameter portion **121'** adjacent the tool bit insertion end.

In Fig. 42D, a tool bit **300'** is held in the longitudinal hole **120^{V}**. The inserted end of the tool bit will push the transition ball **194'** radially outwards in the transition hole **197**. A locking portion **192'** of the sleeve **184'''** effectively blocks the locking ball **170"** from movement in the first radial hole **130'''**, locking the tool bit **300'** in the longitudinal hole **120^{V}**.

Fig. 42C shows the situation when the sleeve **184'''** is pressed towards the tool bit **300'**, starting to release the locking ball **170"** by sliding the locking portion **192'** of the sleeve forwards. The bevelled transition **186"** will push the transition ball **194'** towards the tool bit, to thereby start pushing the tool bit out of the longitudinal hole **120^{V}**. As is shown in Figs. 42C and 42B, the locking portion **192'** of the sleeve has fully cleared the locking ball, allowing the locking ball to slide up in the first radial hole **130'''** sufficiently to not protrude into the longitudinal hole **120^{V}**. This allows the tool bit **300'** to be fully removed from the longitudinal hole. The transition ball **194'** is seated in the first position in the transition hole **195**, blocking any further movement of the sleeve **186'''** in the direction towards the tool bit insertion hole. As soon as the tool bit has left the longitudinal hole, the locking ball can enter the longitudinal hole, as described for earlier embodiments, and thus release the sleeve **186'''** for sliding towards the tool mount **10^{V}**(not shown).

To insert the tool bit **300'**, it is inserted into the longitudinal hole **120^{V}** and pressed down until it is seated at the bottom of the longitudinal hole, simultaneously as the sleeve **184'''** is pressed towards the tool bit side of the holder **100"**. The bottom portion of the tool bit will then first press the locking ball **170"** up in the first radial hole **130'''**.The sleeve is blocked from sliding towards the tool mount **10^{V}** by the transition ball pressing against the bevelled transition **186"**. The situation is identical to what is shown in Fig. 42A, but the tool bit is inserted instead of removed. By inserting the tool bit further, the groove of the tool bit will align with the locking ball **170"**, allowing the locking ball to slide into the groove, whereby the sleeve **184'''** will be slid towards the tool mount **10^{V}** as described earlier. The locking portion **192'** of the sleeve **184'''** will block the locking ball and the tool bit is ready for use in the holder **100"**.

An alternative embodiment to the fourteenth embodiment is shown in Figs. 48A to 51D. The locking ball is replaced in function with a substantially cylindrical locking bar **800**, and the transition ball is replaced in function with a substantially cylindrical transition bar **810**, having a flat side **820**. The locking bar is arranged to slide in a radial first hole **830**, in the same way as described earlier regarding the locking ball. The transition bar **810** is arranged to slide in a second hole **840**, in the same way as described earlier regarding the transition ball. Thus, the functioning of the holder according to Figs. 48A to 51D is identical to the fourteenth embodiment, described earlier. The flat side **820** of the transition bar **810** facilitates the proper orientation of the transition bar but is not essential to the functioning of the holder.

Figs. 45 to 47E show a preferred fifteenth embodiment of a tool holder **100'''** according to the invention. The tool holder is similar to the tool holder according to the fourteenth embodiment described earlier. The holder functions in an identical way to the holder described in conjunction with Figs. 48A to 51D, except that a rocker arm **700**, having a substantially cylindrical locking end **710**, a substantially cylindrical transition end **720**, a connecting bar **730**, fixedly connecting the locking end and the transition end, and a pivot shaft **740** fixedly and perpendicularly arranged in the connecting bar, is pivotably arranged in a rocking arm hole **750** arranged in a connector means **114"**, pivoting on the pivot shaft, which is held by a first rocking arm hole extension **760** and a second rocking arm hole extension **761**. Thus, the holder **100"** comprises the elongate connector means **114"** and an outer sleeve **184'''**. The connector means is attachable to a power tool or hand tool (not shown) via a tool mount **10^{V}**. The connector means **114"** has a longitudinal hole **120^{V}**, which has a cross-section corresponding to the cross-section of the mounting portion of the tool bit. The locking end **710** cooperates with the circumferential groove **305** in the tool bit to lock the tool bit in place when the tool bit is fully inserted into the holder **100'''**. The outer sleeve **184'''** is arranged to reciprocally slide over the connector means **114"** between two end positions, and has a stepped inside diameter, having a smaller diameter part **125'** facing the handle and a larger diameter part **122'** facing the tool bit (for reference numerals of the sleeve see Fig. 44A). A middle diameter part **123'** is arranged between the smaller and the larger diameter

parts, having a diameter which is larger than the diameter of the small diameter part but smaller than the diameter of the large diameter part. The middle diameter part is arranged to house a sleeve biasing means **360'''**. A bevelled transition **186"** is arranged between the large and middle diameter parts. The bevelled transition functions similarly to the depressor described for earlier embodiments in cooperation with the transition end **720**, which will be described in detail later. The sleeve **184'''** has a first end **210"** facing the tool bit insertion hole (longitudinal hole) **120^{V}**, and a second end **220"** facing the tool mount **10^{V}**, when the sleeve is mounted on the tool holder **100'''**. The sleeve biasing means **360'''**, for example a coil spring, is arranged to bias the sleeve **184'''** away from the handle. The transition end **720** is pivotable between a first position at the bottom of the rocking arm hole **750**, to a second position protruding from the top of the rocking arm hole. The bevelled transition **186"** is pressed against the transition end **720** by the sleeve biasing means **360'''**.

In Fig. 45, a tool bit **300'** is held in the longitudinal hole **120^{V}**. The inserted end of the tool bit will push the transition end **720** radially outwards in the rocker arm hole **750**. A locking portion **192'** of the sleeve **184'''** effectively blocks the locking end **710** from movement in the rocking arm hole **750**, locking the tool bit **300'** in the longitudinal hole **120^{V}**.

Fig. 46A shows the situation when the sleeve **184'''** is pressed towards the tool bit **300'**, starting to release the locking end **710** by sliding the locking portion **192'** of the sleeve forwards. The bevelled transition **186"** will push the transition end **720** towards the tool bit, to thereby pivot the rocking arm simultaneously as it will start pushing the tool bit out of the longitudinal hole **120^{V}**. As is shown in Fig. 46B, the locking portion **192'** of the sleeve has fully cleared the locking end, allowing the locking end to pivot up in the rocker arm hole **750** sufficiently to not protrude into the longitudinal hole **120^{V}**. This allows the tool bit **300'** to be fully removed from the longitudinal hole. The transition end **720** is seated in the first position, blocking any further movement of the sleeve **186'''** in the direction towards the tool bit insertion hole. As soon as the tool bit has left the longitudinal hole, the locking end can enter the longitudinal hole, as described for earlier

embodiments, and thus release the sleeve **186'''** for sliding towards the tool mount **10^{V}**(not shown).

To insert the tool bit **300'**, it is inserted into the longitudinal hole **120^{V}** and pressed down until it is seated at the bottom of the longitudinal hole, simultaneously as the sleeve **184'''** is pressed towards the tool bit side of the holder **100'''**. The bottom portion of the tool bit will then first pivot the locking end **710** up in the rocker arm hole **750**.The sleeve is blocked from sliding towards the tool mount **10^{V}** by the transition end pressing against the bevelled transition **186''**. By inserting the tool bit further, the groove of the tool bit will align with the locking end **710**, allowing the locking end to pivot into the groove, whereby the sleeve **184'''** will be slid towards the tool mount **10^{V}** as described earlier. The locking portion **192'** of the sleeve **184'''** will block the locking end and the tool bit is ready for use in the holder **100'''**.

An alternative embodiment to the device shown in Fig. 45 (the fifteenth embodiment) is shown in Figs. 60A to 62C. This embodiment is used for single-ended tool bits **300.** A rocker arm **700''**, having a substantially cylindrical locking end **710'**, a substantially cylindrical transition end **720'**, a connecting bar **730'**, fixedly connecting the locking end and the transition end, and a pivot shaft **740'** fixedly and perpendicularly arranged in the connecting bar, is pivotably arranged in a rocking arm hole **750'** arranged in a connector means **114^{VI}**, pivoting on the pivot shaft, which is held by a first rocking arm hole extension **760'** and a second rocking arm hole extension (not shown, same as Fig. 47C). Thus, the holder **100^{V}** comprises the elongate connector means **114^{VI}** and an outer sleeve **184^{VII}**. The connector means is attachable to a power tool or hand tool (not shown) via a tool mount **10^{V}**. The connector means **114^{VI}** has a longitudinal hole **120^{VIII}**, which has a cross-section corresponding to the cross-section of the mounting portion of the tool bit. The locking end **710'** cooperates with the circumferential groove **330** in the tool bit to lock the tool bit in place when the tool bit is fully inserted into the holder **100^{V}**. The outer sleeve **184^{VII}** is arranged to reciprocally slide over the connector means **114^{VI}** between two end positions, and has a slanted inside diameter, having a first slanted part **122''** facing the tool mount and a second slanted part **122'''** facing the tool bit. A larger

diameter part **122^{IV}** is arranged to press a transition ridge (or cam) **721** of the rocker arm **700"**, when the sleeve is slid over the rocker arm. The constant pressure applied by the larger diameter part against the rocker arm transition ridge eliminates any play in the locking of the tool bit in the holder by the locking portion **710'** of the rocking arm **700"**. Thus any unwanted tool bit movement in the holder is eliminated. The second slanted part **122'''** can alternatively be shaped as a step (not shown). A sleeve biasing means **360'''** is housed in a further larger diameter portion of the sleeve, for pressing the sleeve towards the tool bit insertion side of the holder. The transition end **720'** is pivotable between a first position at the bottom of the rocking arm hole **750'**, to a second position protruding from the top of the rocking arm hole. Insertion of the tool bit, (Figs. 60A to 60E) and removal of the tool bit (Figs. 61A to 61E) is performed analogous to what is described above for the fifteenth embodiment.

Figs. 52A to 52G show different embodiments of double-ended tool bits, which are suitable for use with a holder according to the invention. Fig. 52A shows a double-ended tool holder **300'** as earlier described, having a first tool **306** at one end, for example a screwdriving bit, a second tool **307** at the opposite end, for example a drill bit, and a waist portion **308** with a circumferential groove **305.** The locking ball/locking end described for different embodiments of the invention, advantageously cooperates with the groove **305** to hold the tool bit **300'** in the holder. Alternatively, the locking ball/locking end can cooperate with either end of the waist portion **308**, to securely hold the tool bit in place. Fig. 52B shows a further embodiment of a double-ended tool holder **300"**, having a first tool **306** at one end, for example a screwdriving bit, a second tool **307** at the opposite end, for example a drill bit, and a waist portion **308'** with a plurality of circumferentially arranged circular depressions **305'**. The locking ball/locking end described for different embodiments of the invention, advantageously cooperates with the circular depressions **305'** to hold the tool bit **300"** in the holder. Alternatively, the locking ball/locking end can cooperate with either end of the waist portion **308'**, to securely hold the tool bit in place, as described earlier. Fig. 53C shows a still further embodiment of a double-ended tool holder **300'''**, having a first tool **306** at one end, for example a screwdriving bit, a second tool **307** at the opposite end, for example a drill bit,

and a waist portion **308"** with a plurality of circumferentially arranged concave and elongate first cutouts **305"**. The locking ball/locking end described for different embodiments of the invention, advantageously cooperates with the first cutouts **305"** to hold the tool bit **300"** in the holder. Alternatively, the locking ball/locking end can cooperate with either end of the waist portion **308"**, to securely hold the tool bit in place, as described earlier. Fig. 53D, finally, shows yet a further embodiment of a double-ended tool holder **300^{IV}**, having a first tool **306** at one end, for example a screwdriving bit, a second tool **307** at the opposite end, for example a drill bit, and a waist portion **308'"** with a plurality of circumferentially arranged second cutouts **305'"**. The second cutouts are arranged at the corners of the hex cross-section waist portion. The locking ball/locking end described for different embodiments of the invention, advantageously cooperates with the second cutouts **305'"** to hold the tool bit **300'"** in the holder. Alternatively, the locking ball/locking end can cooperate with either end of the waist portion **308'"**, to securely hold the tool bit in place, as described earlier.

A sixteenth and preferred embodiment of the invention is shown in Figs. 53A to 58B. The holder functions in an identical way to the holder described in conjunction with Figs. 48A to 51D, except that a locking pin **700'**, having a first end **701** with a first slanted surface **703**, a second end **702** with a second slanted surface **705**, a protruding stop **704** arranged substantially around a middle portion of the locking pin, is slidably arranged in a first radial hole **830'** arranged in a connector means **114^{V}**. Advantageously, the locking pin 700' is biased away from the longitudinal hole **120^{VI}** by a resilient spring washer (see Figs. 58A and 58B), having a central cutout **707** corresponding to the cross-section of the locking pin, and a generally curved shape. Thus, the holder **100^{IV}** comprises the elongate connector means **114^{V}** and an outer sleeve **184^{IV}**. The connector means is attachable to a power tool or hand tool (not shown) via a tool mount **10^{VI}**. The connector means **114^{V}** has a longitudinal hole **120^{VI}**, which has a cross-section corresponding to the cross-section of the mounting portion of the tool bit, and a larger diameter portion **120^{VII}**, corresponding to a waist portion **308** of the tool bit (as defined earlier). The second end **702** of the locking pin **700'** cooperates with the waist portion **308** of the tool bit to lock the tool bit in place when the tool bit is fully inserted into the holder **100^{IV}**. The

outer sleeve **184^{IV}** is arranged to reciprocally slide over the connector means **114^{V}** between two end positions, and has a stepped inside diameter, having a smaller diameter part **192'** facing the tool bit insertion side and a larger diameter part **193'** facing the tool mount **10^{IV}**. A bevelled part **191'** is arranged between the smaller and the larger diameter parts. The bevelled part is arranged to cooperate with the first end **701** of the locking pin **700'** as the locking pin slides up or down. A sleeve biasing means **360^{IV}** is arranged to press the sleeve towards the tool mount **10^{IV}**. The bevelled part **191'** is pressed against the locking pin **700'** by the sleeve biasing means **360^{IV}**.

To insert the tool bit **300^{V}**, see Figs. 53A to 53E, the tool bit is inserted into the longitudinal hole **120^{VI}** and pressed down until it is seated at the bottom of the longitudinal hole, simultaneously as the sleeve **184^{IV}** is pressed towards the tool bit side of the holder **100^{IV}**. The second slanted surface **705** of the second end **702** of the locking pin **700'**will first contact the tool bit, see Fig. 53B, whereby the locking pin **700'** is pressed up in the first radial hole **830'**, causing the sleeve to be pressed towards the tool bit. By inserting the tool bit further, see Figs. 53C and 53D, the locking pin **700'** will slide over the waist portion **308** of the tool bit. As is shown in Fig. 53E, the locking pin 700' eventually contacts one end of the waist portion **308**, whereby the tool bit is securely held in the holder **100^{IV}**. The sleeve **184^{IV}** is slid towards the stop ring **365"**, arranged in an annular recess **363'** of the connecting means **114^{V}**, because the locking pin **700'** is allowed to enter the first radial hole **830'** slightly and thus does not block the movement of the sleeve in its biased direction.

In Fig. 54A, the tool bit **300^{V}** is held in the longitudinal hole **120^{VI}**of the holder. If the sleeve **184^{IV}** is pressed towards the tool bit **300^{V}**, the locking pin **700'** is no longer pressed towards the longitudinal hole, and is instead pressed in the opposite direction by the spring washer **706**. The tool bit **300^{V}** can thus be fully removed from the longitudinal hole.

For all embodiments shown in Figs. 41A to 58B, a tool bit ejection means **900** is shown, arranged in the longitudinal hole to abut a step **905** of the longitudinal hole. The ejection

means is preferably a screw spring, but any suitable biasing means may be employed. The action of the ejection means **900** biases the tool bit away from the holder, so that when the tool bit is released from the holder, the tool bit is ejected automatically from the holder. The user only has to release the tool bit with one hand and hold the hand or power tool with the other hand, thus facilitating the release of the tool bit. The arrangement with an ejection spring is applicable to all embodiments of the invention, although it is not shown in all Figs.

Fig. 63A shows a seventeenth embodiment of the invention, which is a further variation of the variation of the seventh embodiment of the invention is shown in Fig. 59. The central washer hole, the profiled entry hole of the sleeve and the longitudinal hole of the connector means all have to be dimensioned to accommodate the larger double-ended tool bit **308^{IV}**. All applicable reference numerals are the same for Fig. 63A as for Fig. 29, except for the elongate connector means **110^{IV}**. The double-ended tool bit **308^{IV}** is also shown in Fig. 63C. The same reference numerals have been used as for Fig. 52A to denote identical technical features. A waist portion **308^{IV}** has a pair of circumferential grooves **305^{IV}**, for cooperation with the long radial protrusion **162** of the washer. A further embodiment of a double ended tool bit **300^{V}** is shown in Fig. 51B. All identical features have the same reference numerals as used for Fig. 51C. The waist portion **308^{V}** has a first circumferential groove **305^{V}** and a second circumferential groove **305^{VI}**. The first circumferential groove has a conical flange portion **309** facing the screwdriving bit, for enhanced gripping of the double-ended tool bit when the drill bit portion **307** is facing outwards from the holder. The second circumferential groove preferably has a normal flange portion **309'**, as also shown for the previous embodiments of the double-ended tool bits. To enhance the cooperation with the washer, the second circumferential groove preferably has a sloping end facing the waist portion **308^{V}**.

Figs. 64 and 65 show a holder as described in Fig. 59 when used with a first embodiment of a drill bit **450**. For reference numerals describing the holder, see Fig. 59. The drill bit preferably has a drill biting portion **455** at one end, a hex-shaped gripping portion **460** at the opposite end, and a retention groove **465** arranged on the hex-shaped

portion. The retention groove cooperates with the washer of the holder to hold the drill bit securely, when the drill bit is inserted fully into the holder.

A second embodiment of a drill bit **450"** is shown in Figs. 66A and 66B. The drill bit has a drill biting portion **455"** and a cylindrical gripping portion **460"**, which the washer cooperates with to hold the drill bit in the holder. A rectangular drive portion **465"** at the proximal end of the drill bit fits into a complementary-shaped proximal or inner end portion of the longitudinal hole **122**, for torque transfer to the drill bit.

A third embodiment of a drill bit **450'''** is shown in Figs. 67A and 67B. The drill bit has a drill biting portion **455'''** and a cylindrical gripping portion **460'''**, which the washer cooperates with to hold the drill bit in the holder. A drive portion **465'''** at the proximal end of the drill bit has a flattened portion which fits into a complementary-shaped proximal or inner end portion of the longitudinal hole **122**, for torque transfer to the drill bit.

A fourth embodiment of a drill bit **450^{IV}** is shown in Figs. 68A and 68B. The drill bit has a drill biting portion **455^{IV}** and a cylindrical gripping portion **460^{IV}** which the washer cooperates with to hold the drill bit in the holder. A drive portion **465^{IV}** at the proximal end of the drill bit has a splined or knurled portion which fits into a complementary-shaped proximal or inner end portion of the longitudinal hole **122**, for torque transfer to the drill bit.

A fifth embodiment of a drill bit **450^{V}** is shown in Figs. 69A and 69B. The drill bit has a drill biting portion **455^{V}** and a cylindrical gripping portion **460^{V}** which the washer cooperates with to hold the drill bit in the holder. A drive portion **465^{V}** at the proximal end of the drill bit has a slot or keyway which fits into a complementary-shaped proximal or inner end portion of the longitudinal hole **122**, for torque transfer to the drill bit.

A sixth embodiment of a drill bit **450^{VI}** is shown in Figs. 70A and 70B. The drill bit has a drill biting portion **455^{VI}** and a cylindrical gripping portion **460^{VI}** which the washer

cooperates with to hold the drill bit in the holder. A drive portion **465**^{VI} at the proximal end of the drill bit has a toothed portion which fits into a complementary-shaped proximal or inner end portion of the longitudinal hole **122**, for torque transfer to the drill bit.

A seventh embodiment of a drill bit **450**^{VII} is shown in Figs. 71A and 71B. The drill bit has a drill biting portion **455**^{VII} and a cylindrical gripping portion **460**^{VII} which the washer cooperates with to hold the drill bit in the holder. A drive portion **465**^{VII} at the proximal end of the drill bit has two flattened opposing sides, creating an ovaloid shape (or a true oval could be formed, of course), which fits into a complementary-shaped proximal or inner end portion of the longitudinal hole **122**, for torque transfer to the drill bit.

An eighth embodiment of a drill bit **450**^{VIII} is shown in Figs. 72A and 72B. The drill bit has a drill biting portion **455**^{VIII} and a cylindrical gripping portion **460**^{VIII} which the washer cooperates with to hold the drill bit in the holder. A drive portion **465**^{VIII} at the proximal end of the drill bit has a bevelled gear portion which fits into a complementary-shaped (i.e. bevel geared) proximal or inner end portion of the longitudinal hole **122**, for torque transfer to the drill bit.

Common to the second to eighth embodiments of a drill bit, as described above, is the necessity to provide a notch or other complementary shape in the holder, which notch or other shape has a cross-section corresponding to the cross-section of the drive portion of the drill bit, to ensure a proper torque transfer from the holder to the drill bit. It should be clearly understood that the preceding examples are not intended to be all-inclusive. Any shape could be used, as long as it engages suitably with the holder for suitable torque transfer.

Fig. 73 shows a further variation of the seventeenth embodiment of the invention shown in Fig. 63A. All reference numerals of Fig. 73 correspond to the reference numerals of Fig. 63A, except a drill bit relief hole **11**, arranged in the tool mount **10'**. A further variation of the fifteenth embodiment is shown in Figs. 74A to 74D. Instead of a spring type sleeve biasing means, a wave spring **950** is used. The wave spring has a first

substantially ring-shaped part **951**, a second substantially ring-shaped part **952** and a distance part **953.** The first part is joined to the second part so that the first part is tilted an angle **α** with respect to the second part. The first part and the second part are joined at one point where also the distance part is joined protruding out from the second part.

Figs. 75A and 75B show a drill bit **970** for use in a holder according to the invention. The drill bit shank has a notch **960** to cooperate with the tilted washer of the holder, and has a proximal end portion **971** to engage a complementary shape **972** so torque can be transferred, for example one of the shapes in Figs. 66-72. The notched shank principle is generally applicable to all drill bit shanks used in the invention, used with a holder having a tilted washer. The notch is not necessarily essential with the tilted washer (angled plate) embodiment, however, since the tilted washer itself may provide sufficient friction to prevent removal of the drill bit from the holder.

Fig. 76 shows that the body can be in two pieces, if desired, namely a back housing and a nose piece. Similarly, the mounting portion or tool mount **10** could be a separate piece from the rest of the body, press-fitted or otherwise secured to the body.

The device according to any of the described embodiments of the invention adds safety to the use of the device, because the device automatically locks the tool bit in the holder after insertion. No action, other than the insertion itself, has to be performed by the user to insert and lock the tool bit in place. As a safeguard, the device has to be actively manipulated in order to release the tool bit from the holder again, but the tool bit will be automatically dislodged during this manipulation, so that the tool bit can be removed from the holder using only one hand.

It will be appreciated that the above description relates to the preferred embodiments by way of example only. Many variations on the invention will be obvious to those knowledgeable in the field, and such obvious variations are within the scope of the invention as described and claimed, whether or not expressly described. For example,

one or more locking balls/locking bars/rocker arms may be employed to achieve the locking function of the invention.